a2

Claim 6. The method of claim 5 wherein linear interpolation is done if the gaps are less than 6 frames.

Claim 23. A computer system for performing a method of determining the sonic slowness of a formation traversed by a borehole comprising generating tracks from sonic waveform peaks received at a plurality of depths, wherein the waveform peaks are not classified prior to tracking, wherein said method comprises classifying long tracks, classifying small tracks, classifying tracks that overlap, filling in gaps and creating a final log, wherein the method is implemented in a program stored on a storage media and the output is applied to at least one output device.

a3

REMARKS

The Examiner bases his rejections under 35 U.S.C. §102(b) and §103(a) in part on Kimball and Marzetta, US Pat. No. 4,591,691 (the '691 Patent). Applicants believe this reference has been misapprehended with respect to the present invention. The '691 Patent teaches a method that limits peaks to particular time-slowness band definitions (classifies) prior to deriving logs (tracking) based on these classified peaks. Referring to Fig. 1 and column 5, lines 5 to 34, the '691 Patent teaches a method wherein the output of sonic receivers is stored in storage **30** and then transferred to unit **32** which finds a coherence measure for arrival time (T) and slowness (D) only within a band of (T, D) which is likely to be relevant (i.e. classification of peaks), after which coherence peaks **34** for each relevant depth are found, and then at unit **36** new logs are derived on the basis of the peaks found in unit **34**.

Additionally, the '691 Patent further describes how "a search for peaks is made only in a certain band of time-slowness space, and a carefully selected definition of a peak is used"[1] as follows:

[1] '691 Patent, col. 8, lines 16-18.

> At step 106 the coherence measure is found for each (T,D) combination in the band of permissible combinations, e.g. in accordance with the process discussed in connection with expressions (3), (4), (5) and (6). At step 108 the peaks of coherence measure within the band are found, e.g., in accordance with the procedure discussed in connection with expressions (7)-(10), and at step 110, for each of the peaks found in step 108, the process finds and stores the energy time of arrival T_c, the slowness D, the coherence measure and the coherent energy.

('691 Patent, col. 11, lines 2 to 12, emphasis added)

As such, the '691 Patent teaches generating coherence peaks only in time-slowness band that correspond to a pre-defined time-slowness band (also referred to therein as a peak mask or map). That is, according to the method of the '691 Patent, classification of received signals with respect to a pre-defined time-slowness space occurs prior to creating a track or log.

In contrast, the present invention discloses a method of determining sonic slowness wherein the waveform peaks are not classified prior to tracking. As shown in Fig. 3, the present application entails tracking the waveform peaks with depth without previous classification of the peaks. The peaks tracked in the present invention may include peaks corresponding to compressional, shear or Stoneley waves at any particular depth (page 9, lines 16-23).

Independent claim 1 and dependent claims 2 to 12 and 15 to 18 were rejected under 35 U.S.C. §102(b) as being anticipated by the '691 Patent. Applicants respectfully traverse these rejections and request reconsideration of these claims. The '691 Patent teaches a method of determining sonic slowness based on classified peaks: it does not teach the method of claim 1 and its dependent claims in the present application wherein waveform peaks are not classified prior to tracking. Applicants note the citation referenced by the Examiner in his rejection of claim 1 ('691 Patent, col. 11, lines 21-22, figures 9-10) refers to peaks to which peak masks or maps were already applied as discussed above. In particular the "(2) slowness/time coherence log discussed above" directly entails step **106** of figure 5, finding "coherence measure R^2 (T,D) for all (T,D) in permitted band". Thus,

the logs to which the cited passage from the '691 Patent refers have already been classified.

Further, with respect to claim 2, '691 Patent does not teach 1) classifying long tracks; 2) classifying small tracks; 3) classifying tracks that overlap; filing in gaps; and creating a final log. Rather, the '691 Patent teaches a sliding time window (col. 14, line 42). As such, the '691 Patent does not teach each and every element of claim 2 of the present invention.

With respect to claim 3, the '691 Patent does not teach filling in the gaps using non-classified tracks. Rather the cited passage of the '691 Patent teaches testing the coherence measure at a given T, D point against the coherence measured for the immediately adjacent points in the T*, D* mask. That is, it teaches comparing classified peaks at a given T,D point with adjacent points in the peak mask. Nor does the '691 Patent teach each element, such as the use of interpolation, of claims 4 and 7. In addition the '691 Patent does not teach each element of claim 5 such as the use of linear interpolation, nor the use of linear interpolation if small gaps are less than 6 frames as claimed in claim 6 of the present invention.

As the '691 Patent method comprises classifying peaks in accordance with a peak mask (see col.12, line 65 to col. 13, line 34; col. 9, lines 38 to col. 10 line 5; Figures 9 and 10), it does not teach a method wherein peaks are not classified prior to tracking and wherein tracks are considered as individual objects comprising peaks as claimed in claim 8 nor a method wherein said peaks are defined using semblance, time and slowness as claimed in claim 9 of the present invention. Neither does the '691 Patent teach the elements of claim 10 (wherein only time and slowness are used for classification), claim 11 (wherein a probability of a track being compressional or shear is determined using all points forming the track, or claim 12 (wherein classification of one track is independent of classification of a track different from said one track).

The Examiner cites the following passage of the '691 Patent to support his rejection of claim 15 of the present invention under 35 U.S.C. §102(b):

> Yet another technique discovered to assist in speeding up the invented process and make it more practical is used in the peak search and involved first testing the coherence measure at a given T,D point (see expression (10)) against the coherence measures for the immediately adjacent points in the T*, D* mask and, if needed, expanding the search in larger concentric squares.

For comparison, claim 15 of the present invention is presented below:

> The method of claim 2, wherein step of filling in the gaps further comprises:
> determining if there is a gap in a selected track at a depth range covered by the selected non-classified track;
> deleting the track if no gap is found; and
> filling the gap in the selected track after determining that the selected non-classified track can be used to fill the gap.

As can been seen above, the cited '691 Patent reference does not teach each and every element of claim 15 of the present application.

Claim 16 depends on claim 15, which further depends on claims 2, and claim 1; the remarks above pertaining to claims 1, 2 and 15 are similarly made with respect to claim 16. The Examiner references a method of restricting slowness to expected arrival boundaries disclosed in the '691 Patent (col. 8, lines 30-53) to support rejection of claim 16 of the present application. But the '691 Patent does not teach nor disclose determining if the selected track can be used to fill the gap by evaluating if the selected track is between upper and lower part of a skeleton, wherein said skeleton comprises tracks that have been classified so far. Rejections of claims 17 and 18 under 35 U.S.C §102(b) are addressed by the remarks to the respective independent claim upon which they depend.

As each element of claim 1-12 and 15-18 are not present in the cited reference, it does not anticipate the present application and Applicants respectfully traverse and request reconsideration of these 35 U.S.C. §102(b) rejections.

Claim 23 is amended herein.

The Examiner rejected claims 13, 14, 19-22, and 24 under 35 U.S.C. §103(a) over '691 Patent in view of Kimball, US Pat. No. 6,449,560 (the '560 Patent). Applicants respectfully traverse these rejections: such a combination does not teach or suggest the present invention nor would such a combination perform the function of the present invention. The '691 Patent teaches a method that involves producing sonic logs on the basis of selected parameters of coherence peaks (see claim 1, as well as peak mask 53 and permissible band 49 on Fig. 4). The '560 Patent describes the shortcomings in windowing sonic waveforms using peak mask or maps such as described in the '691 Patent. As stated in the '560 Patent:

> The windowing procedure employs a time window of selected duration that is judiciously positioned to separate a desired wave from other waveforms components because the subsequent processing is valid only for particular wave types. Positioning the window has always been a problem because the output estimates depend significantly on window position. To believe an estimate, one must believe the window is positioned properly. In practice, window positions are often untenable from a physical point of view. Moreover, windowing is known to introduce bias in the measurement.

(col. 1, lines 44 to 53).

The '560 Patent teaches selecting model values of said acoustic properties and using those model values in determining output acoustic property values (see claim 1, column 2, lines 34-47). It specifically teaches forming different matrices based on different wave types (col. 10, lines 22-43). As such, a combination of these two references as suggested by the Examiner would not suggest the present invention but rather would teach generating tracks from output acoustic properties selected from a maximized test statistic as compared to model values.

Rather than such a windowing or modeling technique, the present invention comprises a method of determining sonic slowness by generating tracks from sonic waveform peaks received at a plurality of depths wherein the waveform peaks are not classified prior to tracking. That is, the tracks of the present invention may include all peak arrivals for each depth without previous classification of the peaks (page 9, lines 18 to 24). The

present invention does not require use of model values or other methods of classification prior to generating tracks; in the present invention, peaks are not classified prior to generating tracks. The present method therefore avoids shortcomings inherent in comparing received data to a pre-selected model prior to generating a track. As the combination noted by the Examiner would not achieve the present invention, nothing in these cited references suggests such a combination to one skilled in the art such as to render the present invention obvious.

Further, such a combination of the '691 Patent and '560 Patent would not teach or suggest fitting a distribution function on unclassified peaks of the track, calculating a mean and variance of the distribution, comparing distribution of the data with a distribution of a model data, and then classifying a long track according to the model data as claimed in claim 13 of the present invention. Nor would a combination of the '691 Patent and the '560 Patent suggest computing a 2-D median of a short track, said median being a point defined by corresponding coordinates in a slowness and time domain; determining an intersection of the slowness and time domain with a model data distribution; defining the model in the slowness and time domain as an ellipse; and classifying the small track based on a position of the peak in relation to model data as claimed in claim 14 of the present application. Claims 19-22 depend on claims 13 and 14 or intervening claims and the remarks provided herein likewise apply to claims 19 through 22. It is likewise apparent that a combination of the '691 Patent and '560 Patent as suggested by the Examiner would likewise not teach or suggest the elements of claim 24 of the present application. For the above-stated reasons and other remarks that may be made, Applicants respectfully traverse the rejection of claim 13, 14, 19-22 and 24 under 35 U.S.C. §103(a) and request reconsideration of these claims.

Applicants believe this reply is fully responsive to every issue raised by the Examiner in the Office Action dated January 17, 2003. If this belief is incorrect or other issues arise, please do not hesitate to contact the undersigned. To facilitate such contact, it is suggested the Examiner send an electronic mail (Email) message to the undersigned, to which the undersigned will promptly respond by telephone during the Examiner's normal

working hours. The Commissioner is hereby authorized to charge the amount necessary to cover the any fee that may be due or to credit any overpayment to Deposit Account 50-1122.

Sincerely,

Robin Nava
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Date: 10-APRIL-2003

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VERSION WITH CHANGES MARKED

In the claims:

Claim 1 (amended). A method of determining the sonic slowness of a formation traversed by a borehole comprising generating tracks from sonic waveform peaks received at a plurality of depths, wherein the waveform peaks are not classified prior to tracking.

Claim 6 (amended). The method of claim 5 wherein linear interpolation is done if the [small] gaps are less than 6 frames.

Claim 23 (amended) A computer system for performing a method of determining the sonic slowness of a formation traversed by a borehole comprising generating tracks from sonic waveform peaks received at a plurality of depths, wherein the waveform peaks are not classified prior to tracking, wherein said method comprises classifying long tracks, classifying small tracks, classifying tracks that overlap, filling in gaps and creating a final log, wherein the method is implemented in a program stored on a storage media and the output is applied to at least one output device.